

Original Research Article

A study on patients with coronary artery disease with special reference to bone mineral density

Tony Ete¹, Shakeel Ahamad Khan¹, Baphira Wankhar², Star Pala³, Amit Malviya¹, Habung Mobing⁴, Narang Naku⁵, Amethyst Bamon¹, Utpal Kumar¹, Arun Kumar¹, Vanlalmalsawmdawngliana Fanai¹, Stephenson Pohlong², Animesh Mishra^{1*}

¹Department of Cardiology, ²Department of Radiology, ³Department of Community Medicine, ⁴Department of General Medicine, ⁵Department of General Surgery, NEIGRIHMS, Shillong, Meghalaya, India

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*Correspondence:

Dr. Animesh Mishra,

E-mail: dranimeshmshillong@gmail.com

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ABSTRACT

Background: Osteoporosis and Coronary artery disease are known to share common risk factors, like inflammation, but a direct relationship between the two has not been established. Some of the previous studies showed low BMD (osteoporosis and/or osteopenia) as an independent predictive factor for coronary artery disease in ambulatory patients. However, some reports have failed to demonstrate a direct relationship between low bone mineral density (BMD) and CAD or cardiovascular risk factors. This study was carried out to estimate bone mineral density (BMD) in patients with coronary artery disease (CAD) and also to evaluate the association between bone mineral density and coronary artery disease.

Methods: Hospital based prospective observational study, involving 96 consecutive patients who were referred for coronary angiography for the evaluation of established or suspected CAD and also patients who had acute coronary syndrome (ACS) are enrolled in this study. BMD was determined for the lumbar spine (L2-L4) and femoral neck using DXA scan.

Results: The total number of subjects was 96. Out of 96, 24 (25%) patients were females and remaining 72 (75%) were males. Coronary angiography was carried out in all patients. 42 patients from the total had coronary angiography proven single vessel disease (SVD), 33 patients had double vessel disease (DVD) and 21 patients had triple vessel disease (TVD). DXA scan was carried out in all patients. T- score of neck of femur region and lumbar spine was calculated. Neither the presence of significant coronary stenoses $\geq 50\%$ in two or more coronary vessels nor the prevalence of severe coronary stenoses $\geq 70\%$ differed significantly between patients with normal bone density, osteopenia, or osteoporosis ($p < 0.05$, respectively).

Conclusions: The result of this study suggests that in patients undergoing coronary angiography for the evaluation of CAD, the prevalence of low BMD is high; however, there is no statistically significant relationship between osteoporosis, osteopenia and coronary artery disease state.

Keywords: Coronary artery disease, DXA scan, Osteoporosis, Osteopenia

INTRODUCTION

Osteoporosis and coronary artery disease (CAD) are known to share some common risk factors, like

inflammation, but a direct relationship between the two is missing. Investigations at the basic and clinical level have documented increased receptor activator of nuclear factor kappa ligand (RANKL) as well as levels of

osteoprotegerin (OPG) in atherogenesis and bone loss.¹ Marcovitz et al primarily described that low BMD is an independent predictive factor for CAD in ambulatory patients predominantly in women.² On the other hand some reports have failed to demonstrate a direct relationship between low bone mineral density (BMD) and CAD or cardiovascular risk factors in post-menopausal women.³ Furthermore, according to angiography findings, low BMD in men is associated with CAD complications.⁴ In this background, we plan to undertake this study to assess whether there is an association between BMD and CAD in patients attending a tertiary care centre in north-eastern India.

METHODS

Study was carried out in a tertiary health care centre in north eastern India. Hospital based prospective observational study, involving 96 consecutive patients who were referred for coronary angiography for the evaluation of established or suspected CAD and also patients who had acute coronary syndrome (ACS) are enrolled in this study. Information on conventional cardiovascular risk factors was obtained by a standardized interview. Under resting conditions systolic and diastolic blood pressure was measured by the Riva-Rocci method. Height and weight were recorded, and body mass index was calculated as body weight (kg)/height (m)².

All the patients were taking aspirin, 90% patients were taking statins, 70% on beta blockers, 50% on angiotensin converting enzymes inhibitors (ACEi) and 38% on angiotensin receptor blockers (ARBs). The study was approved by Institution Ethics Committee (IEC) and all participants gave written informed consent. Venous blood samples were collected after an overnight fasting before angiography was performed, and laboratory measurements were performed from fresh serum samples.

The serum levels of triglycerides, total cholesterol, and high density lipoprotein (HDL) cholesterol were also determined. BMD was measured by dual energy X-ray absorptiometry (DXA) at the lumbar spine (L1 to L4) and at the hip (Neck of Femur on both sides). BMD data of lumbar spine and hip were used in this study (Figure 1). BMD results according to World Health Organization (WHO) criteria were classified into three groups: normal (Tscore \geq -1.0 SD), osteopenia (T-score between -1.0 and -2.5 SD), and osteoporosis (T-score \leq -2.5SD). Selective coronary angiography was performed by the Judkins technique.

The angiograms were recorded in multiple projections. Cineangiograms were reviewed by cardiologists who were blinded to DXA results. Stenoses were identified, and the percentage of lumen diameter stenoses was assessed by visual analysis. CAD was diagnosed in the presence of any lumen narrowing at angiography and coronary stenoses of 50% or more were considered

significant obstruction. A written informed consent was taken from the patient / patient attendant prior to selection for the study.

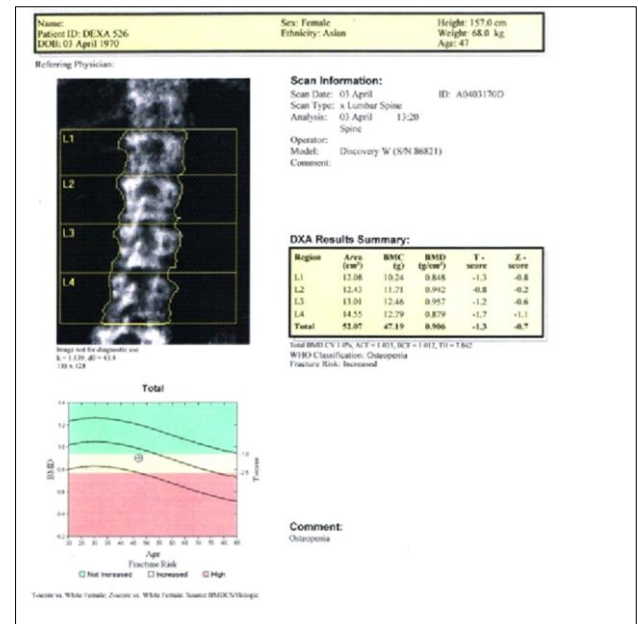


Figure 1: Sample of report of DXA scan.

Table 1: Clinical characteristics of the patients showing low T-scores for both lumbar spine and neck femur.

	Mean \pm SD	Range
Age (in years)	44.64 \pm 6.26	(27-59)
Hb (gm/dl)	13.62 \pm 1.35	(10.2-16.8)
Urea (mg/dl)	25.2 \pm 7.79	(10-50)
Creatinine (mg/dl)	1.11 \pm 0.21	(0.7-1.7)
TS-Lumbar spine	-1.54 \pm 1.21	(-3.6-1.9)
TS-Neck femur	-1.10 \pm 1.13	(-2.6-2.8)
Height (cm)	164.20 \pm 5.04	(154-175)
Weight (kg)	64.72 \pm 8.46	(48-90)

**TS- T-score. Hb-Hemoglobin

According to the WHO criteria, Osteoporosis is defined as bone density (T score) 2.5 or more standard deviations (SD) below the young adult mean (-2.5 SD or lower), and osteopenia as T-score between 1 and 2.5 SD below the young adult mean -1<T score \leq -2.5.⁵ Bone mineral density (BMD) was determined for the lumbar spine (L2-L4) and femoral neck using dual-energy X-rays absorptiometry (DXA) scan.⁶ The BMD values for the regions of interest (ROI) was measured by T and Z score values. T-scores were measured by taking the difference between a patient's BMD and the mean BMD value in healthy young adults, which is matched for sex and ethnic group, and presenting the difference relative to the young adult population standard deviation.⁷ Coronary angiography was performed with the standard Judkin's method using angiography device. Stenosis of more than 50% has been considered as CAD.

Statistical analysis

Descriptive statistics were expressed as mean±standard deviation (SD) for continuous variables and proportion (%) or frequency for categorical variables. Correlations between the variables were assessed by the Pearson coefficient analyses. Multivariate logistical regression analysis was performed to ascertain the association of BMD results as a dependent variable and other independent variables. A p value <0.05 was considered as statistically significant. Statistical analysis was performed using the SPSS software package

RESULTS

The study was conducted in department of cardiology of a tertiary health care centre. The total number of subjects was 96. Out of 96, 24 (25%) patients were females and remaining 72 (75%) were males (Figure 2).

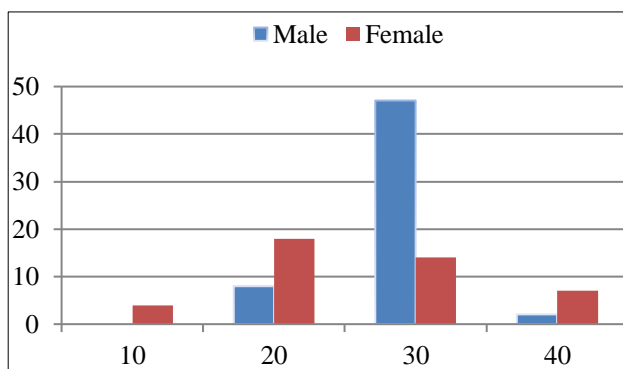


Figure 2: The pattern of age distribution in males and females.

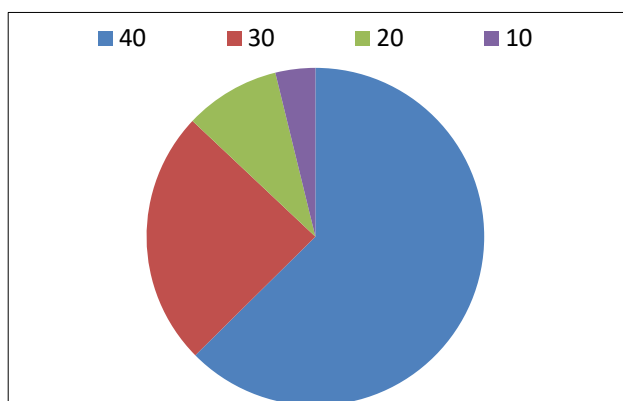


Figure 3: Age distribution (group wise). Blue segment (number 1) representing age group from 41-50years of age, Red segment(number 2) from 31-40 years of age, Green segment (number 3) from 51-60 years of age, purple segment (number 4) 21-30 years of age.

The baseline demographic data of the 72 men were characteristic for a male cohort undergoing coronary angiography for the evaluation of CAD. The mean age of the patients was 44.64 ± 6.26 years. Most of the patients

were between age group from 41-50years of age and few patients were under 21-30 years of age (Figure 3).

Statistically 29 patients were having type 2 diabetes mellitus. Among 96 patients, 65 patients were hypertensive and 59 patients were smokers. The mean hemoglobin level of all patient was 13.62 ± 1.35 gm/dl. Most of the patients had normal renal function tests. Mean urea level was 25.2 ± 7.79 mg/dl and creatinine level was 1.11 ± 0.21 mg/dl respectively. Height and weight of all patients were taken. The mean height of patients was 164.2 ± 5.04 cm and weight was 64.72 ± 8.46 kg. Coronary angiography was carried out in all patients. 42 patients from the total had angiography proven single vessel disease, 33 patients had double vessel disease and 21 patients had triple vessel disease. DEXA scan was carried out in all patients. T score of neck of femur region and lumbar spine was calculated. Out of 96 patients, 36 (37.5%) patients had their T-score within the normal range, 32 (33.3%) patients had osteopenia and remaining 28 (29.2%) patients had osteoporosis (Figure 4). Decreased BMD was significantly associated with older age, lower BMI, higher HDL cholesterol and with a history of smoking.

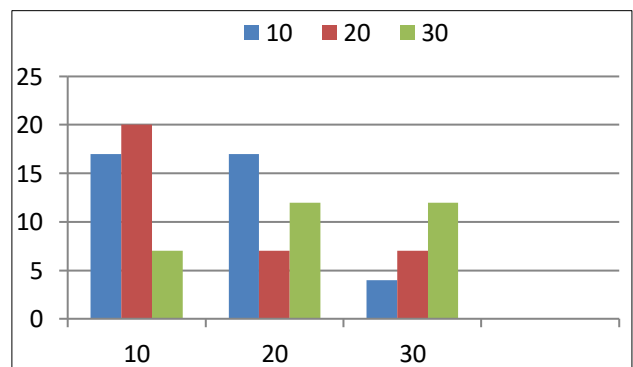


Figure 4: The relationship between coronary artery disease and its severity with T-score of Lumbar spine. BLUE (number 1) represents patients with normal bone, RED (number 2) represents group of patients with osteopenia, GREEN (number 3) represents patients with osteoporosis.

No patients in the study group were taking any bone specific drugs as calcitonin, parathyroid hormone or vitamin D supplementation. Out of 96 patients, 86 patients showed disease of the coronary artery involving the left anterior descending (LAD) artery, 40 patients showed involvement of left circumflex artery (LCX) and 44 patients showed involvement of right coronary artery (RCA). Neither the presence of significant coronary stenoses $\geq 50\%$ in two or more coronary vessels nor the prevalence of severe coronary stenoses $\geq 70\%$ differed significantly between patients with normal bone density, osteopenia, or osteoporosis ($p > 0.05$, respectively). Similar results were obtained when the patients with osteopenia and those with osteoporosis were pooled to a single group with low BMD.

DISCUSSION

There is no conclusive relationship between bone mineral density (BMD) status of a patient with coronary artery disease (CAD) till now. Chen SS et al, in their population-based cohort study, supported an association between osteoporosis and CAD in Asian population.⁸ This retrospective study showed there was a statistically significant association between coronary artery disease and osteoporosis comprising 19456 patients. In other study comprising 661 patients who underwent low-dose multidetector computed tomography coronary angiography (MDCT-CA) and dual-energy X-ray absorptiometry (DXA), the researchers demonstrated that the association between the presence of subclinical coronary calcification and low BMD among middle-aged men and women was not significant after controlling for age and other risk factors for CAD and osteoporosis.⁹

In this study, out of 96 patients, 36 (37.5%) patients their T score within the normal range, 32 (33.3%) patients had osteopenia and remaining 28 (29.2%) patients had osteoporosis. Taken together 60 (62.5%) patients in the study had low BMD according to the T-score obtained. From this data we can conclude that in patients undergoing coronary angiography for the evaluation of CAD the prevalence of low BMD is high; however, there is no statistically significant relationship between osteoporosis, osteopenia and coronary artery disease state. As per the WHO definition, in this study 33.3% patients had osteopenia, 29.2% had osteoporosis resulting in 62.5% undergoing coronary angiography having low BMD. Beer S et al in their study found the prevalence of osteoporosis and osteopenia as defined by WHO criteria was 10.5% and 33.1%, respectively in the men who underwent angiography.¹⁰ The prevalence of osteoporosis in unselected postmenopausal women has been described to range from 7% to 19%.¹¹ Generally, the data available on the prevalence of low BMD for men is insufficient, particularly, no data for BMD in male patients with coronary artery disease (CAD) are available at all. Possible reasons behind the high prevalence of low BMD in this study may be because of average age of our patients. Low BMD in our this study may also be due to high prevalence of smoking, and lack of physical activity due to symptoms resulting from coronary artery disease.¹² Even though the prevalence of osteopenia and osteoporosis was higher in this study, most of the patients were unaware of the status of their bone mineral density (BMD).

Almost all of the patients were not undergoing any kind of treatment for the low BMD status before the test. It has been suggested in one study that osteoporosis and coronary artery disease (CAD) have overlapping pathophysiological mechanisms and related risk factors and also they suggested that an association of low BMD and elevated CAD risk exists. However, additional longitudinal studies are needed to determine the temporal sequence of this association.¹³ This study confirms the

underdiagnosis and undertreatment of osteoporosis in patients with cardiovascular disease.¹⁴ This study highlights the importance of BMD screening among patients with coronary disease as further bone loss may lead to increased chance of fracture and comorbidities. Men with CAD and overt osteoporosis may be considered for pharmacologic therapy.¹⁵ Treatment with calcium and vitamin D supplements may be considered in patients with osteopenia to avoid further bone loss.

This was an observational study where patient's bone mineral density was assessed single time. Longitudinal studies are needed to determine the temporal sequence of this association. The study being a hospital based study, there is always a chance of selection bias and subjects might not be the ideal representative of the population. Total number of patients under study was 96 which is less. A larger number of study population would have made this study more accurate and added further weightage to the results these were the few limitations of the study.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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